

Brad Jackson

05/15/2002 12:57 PM

To: Mike Stephenson/R4/USEPA/US@EPA
cc:
Subject: Re: Radium/Radiation PRGs/Cleanup Goals

Mike:

Here's an interesting message that I received a while back from Region 10.

Brad

----- Forwarded by Brad Jackson/R4/USEPA/US on 05/15/2002 11:39 AM -----

SITE: Florida Phosphate
BREAK: 10.1
OTHER: V.1

Rick Poeton

02/21/2002 11:26 AM

To: Brad Jackson/R4/USEPA/US@EPA
cc: Jon Richards/R4/USEPA/US@EPA
Subject: Re: Radium/Radiation PRGs/Cleanup Goals

The dose levels WERE NOT reconciled with the CERCLA risk range. It was understood early on that dealing with the problem in the context of CERCLA and using the CERCLA criteria would lead to the conclusion that risks in many homes were "unacceptable". Measured gamma dose levels in excess of 15 mrem/year and ranging into a few 100s mrem/year would be unacceptable in a CERCLA evaluation. But the consequent potential actions regarding homes (demolition, abandonment, major rehab) were simply not acceptable to the community. This is a clear case where the CERCLA process and decision criteria broke down. The community (with the complicity of the companies involved) could see where the process would take them and simply refused to go there. The decision was made not to address the problem under CERCLA but to work out an agreement with the companies in a different context (a RCRA Consent Order) and to develop voluntary guidelines for the public.

I have pointed this example out to the radiation risk folks in OERR more than once, making the point that their narrow construction of acceptable risk and dose means that there are cases like this where CERCLA doesn't work. Yet we felt the issue could not simply be ignored. What we wound up doing (with help from ATSDR) was developing voluntary guidelines based on non-CERCLA sources such as ICRP, NCRP etc. We brought in the concept of ALARA, but in retrospect I think we could have done a better job along those lines. The problem is that although EPA incorporates ALARA one way or another into much of its radiation protection logic and regulation, there is no good detailed guidance on how to implement ALARA or decide what is ALARA in specific cases. In our case, it turns out the ALARA is the governing concept in decisionmaking and recommendations for the public. If I had it to do over, I would try to flesh out the ALARA logic and criteria in more detail to support the recommendations.

For their part, the OERR folks (correctly) see this as outside their CERCLA framework, and therefore do not view it as precedent. If the community perspective had been different (as I think yours may be), I suppose we might have been able to proceed under CERCLA. In that case, it is likely that investigation and decisions would have been straightforward. Direct gamma radiation measurements would have been all that was needed to identify locations for remediation. Probably we could have made the case that slag roads were a small risk based on occupancy factors. For buildings where slag was incorporated into the structure, however, I think large scale remedial impacts would have been unavoidable.

One creative approach that we talked about but did not try is "risk exchange". The slag in homes (in our case) is a gamma source only with no real contribution to indoor radon. The houses, of course, all have some naturally occurring radon, the risks from which far exceed even the high gamma levels we were seeing in homes from slag. So one approach would be to evaluate the slag gamma risk but "remediate" it by reducing a "similar" risk (radon) in the same buildings. It would not take much radon reduction to make up for a hundred or so mrem/year of gamma. In effect this would reduce background as a substitute for addressing the "release-related" risk. I am not aware that CERCLA has ever done something like this. There are conceptual problems like: does this mean that a PRP could install smoke detectors or institute a "quit smoking" program instead of cleaning up a contaminated site? Nonetheless, it might be a way to keep the process under CERCLA but not wind up tearing down homes. It might also make sense to the public. And as part of a site-specific resolution to a difficult problem it might work.



10584003

I am also very interested in how Region 4 will handle a similar set of concerns. So keep in touch. Glad to discuss more detail if you want: 206-553-8633.


Brad Jackson

Brad Jackson

02/21/2002 07:05 AM

To: Rick Poeton/R10/USEPA/US@EPA

cc:

Subject: Re: Radium/Radiation PRGs/Cleanup Goals 

Rick:

Thanks for the information...it was very helpful.

The way that radiation was dealt with at phosphorus slag sites was very interesting. I'm most interested in how the higher dose levels of 100 to 500 mrem/yr were reconciled with HQ's recommended risk range of 10-4 to 10-6. We are dealing with some similar issues in Region 4 with the large phosphate mining sites.

The response may be too long for an e:mail, so feel free to call me at 404-562-8925.

Thanks, Brad



GRADED DECISION GUIDELINES FOR PHOSPHORUS SLAG

Guidance for Individuals to Use in Determining Appropriate Actions to Reduce Radiation Exposure Due to Phosphorus Slag

As recommended to the U.S. Environmental Protection Agency by the Southeast Idaho Technical Work Group on Slag

I. Introduction

What is slag?

Elemental phosphorus slag is a byproduct of elemental phosphorus. The slag contains natural radioactive material at levels higher than found in most ordinary rock and soil. This radioactive material emits gamma radiation which is a type of radiation similar to medical x-rays. Phosphorus slag has been used in residential construction, streets, sidewalks, and construction fill in Pocatello, Soda Springs, and nearby areas of southeastern Idaho, including Caribou, Bannock, and Power Counties.

What prompted concern about slag?

The EPA performed a study of the potential radiation doses from slag received by residents in southeastern Idaho. One of the conclusions was that some citizens in Pocatello and Soda Springs could be at elevated risk of getting cancer due to long term exposure to slag. The EPA Science Advisory Board reviewed the report of the study following its release in 1990 and made recommendations which included:

- conducting further tests to determine actual radiation exposure to individuals;
- establishing a set of "graded decision guidelines" to help individuals interpret their exposure results and determine what, if any, actions should be taken to reduce that exposure. These guidelines will be based upon technical and economic factors for both short-term and long-term public exposure due to past uses of slag. The Science Advisory Board also recommended that the guidelines be made available for public review.
- working with local and state officials, the public and industry to make measurements for individuals based on their particular exposure conditions.

How were these concerns to be addressed?

To address these recommendations, a Technical Work Group was created in November of 1992. The Technical Work Group includes representatives from:

- EPA,
- the State of Idaho,

- FMC,
- Monsanto,
- the Shoshone-Bannock Tribes,
- the Agency for Toxic Substances and Disease Registry, and the communities of
- Soda Springs and
- Pocatello.

The Technical Work Group was created to assist EPA and the companies in the design of the Methods Development Study and to assist EPA in implementation of the exposure studies and the development of graded decision guidelines.

This document is the Technical Work Group's recommendations to EPA for graded decision guidelines. This version includes changes and recommendations made at the June 1, 1995, Technical Work Group meeting.

II. Radiation terms and perspective

How much radiation occurs "naturally?"

Dose from various sources of radiation can be expressed in terms of a single quantity, millirem, which is abbreviated mrem. If all ordinary sources of radiation dose are included, such as from natural gamma rays, cosmic rays, radon, **medical** procedures, consumer products and miscellaneous sources, the U.S. national average dose is about **360** mrem per year. Annual doses received by specific individuals can vary considerably from this average value. The average dose from sources except slag in Pocatello and Soda springs is expected to be about 400 mrem per year because levels of natural radiation are higher than the national average. The natural background in the Soda Springs and Pocatello areas from natural gamma rays and cosmic rays alone, while average about 100 mrem per year.

What is the risk from radiation?

Dose from slag radiation is in addition to these amounts. For radiation protection purposes, risk is usually assumed to be proportional to dose. According to the International Commission on Radiological Protection, 100 mrem would have an associated potential risk of fatal cancer of five in one hundred thousand. Table II-1 lists examples of radiation exposures, standards and recommendations.

Table II-1. Examples of radiation exposures, standards and recommendations

Exposure Condition	Annual Dose (mrem)
Radiation worker limit	5,000
Radon daughter limit for uranium miners	4,000
Indoor radon level for which action is recommended by EPA(United States Environmental Protection Agency) (4 pCi/L)	1,000
Lowest radon level for which EPA(United States Environmental Protection Agency) recommends that homeowners consider remedial action (2pCi/L)	500
NCRP(National Council on Radiation Protection and Measurements) remedial action threshold (including background)	500
NCRP(National Council on Radiation Protection and Measurements) recommended limit for infrequent exposure of the public from facilities that emit radiation or radioactivity	500
Average dose to U.S. citizen from all sources	360
Average radon exposure (0.8 pCi/L)_	200
Gamma radiation limit for buildings contaminated with uranium mill tailings (above background)	175
Typical dose to civilian air crews	160
NCRP(National Council on Radiation Protection and Measurements) recommended limit for continuous or frequent exposure of the public from facilities that emit radiation or radioactivity	100
U.S. average natural background except radon	100
U.S. average for diagnostic radiological medical procedures	53
One transcontinental round trip per year by air	5

III. Summary of the graded decision guidelines

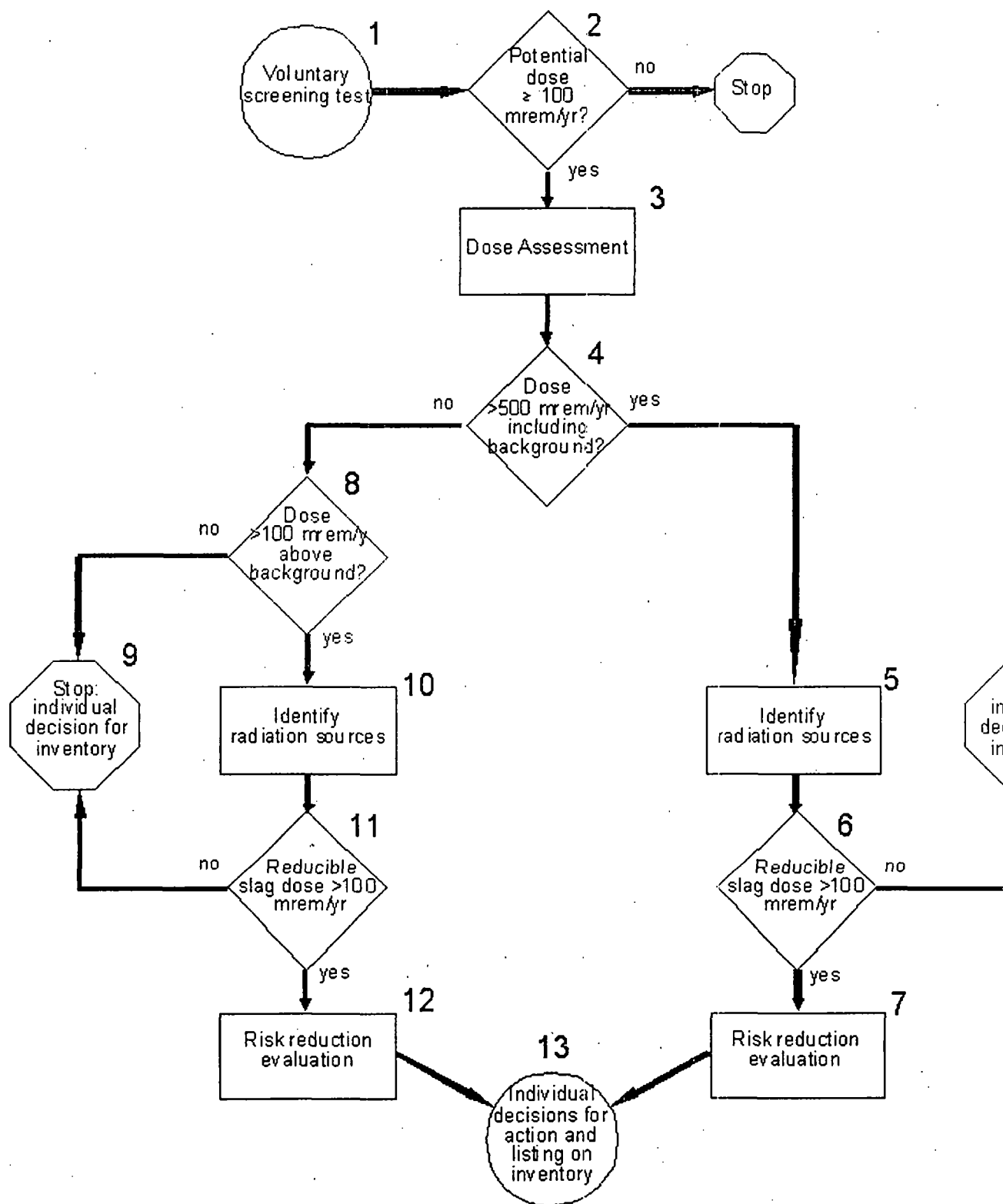
What guidelines can be used for making decisions about slag?

The graded decision guidelines may be summarized briefly as follows:

1. For individual doses which exceed 500 mrem per year including natural background, action is recommended if a reduction of at least 100 mrem per year from slag can be achieved. A list of actions to reduce exposure is available.
2. For individual doses less than 100 mrem per year above background, no action is recommended.
3. For individual doses between 100 mrem above background and 500 mrem including background, it is recommended that actions be considered to reduce exposure if a reduction of at least 100 mrem per year from slag can be achieved. A menu of options to reduce exposure is available.

The graded decision guideline process is given in more detail below. A flow chart illustrates the process and each "box" in the chart is described in a numbered list corresponding to the numbers on the flow chart (section IV). The recommended processes for collecting data to support the graded decision guidelines are included and discussed briefly for clarity where appropriate. A list of options for risk reduction actions is keyed to dose levels in section V. Finally, radon as a source of radiation exposure in dwellings is discussed

in Section VI.



IV. Notes on the graded decision guideline flow chart

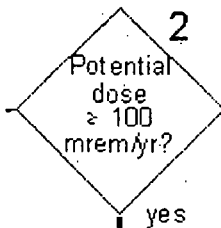
The numbers below correspond to the numbered blocks on the flow chart:



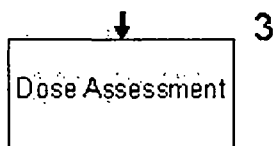
1 Residents in the designated areas will be offered an opportunity to participate in a screen test for elevated exposure rate.

1.1 Residents will be offered screening with a portable survey instrument (meter). If accepted, the dwelling will be surveyed with a sensitive meter capable of measuring in the $\mu\text{R/h}$ range. As a practical matter, if the exposure rate is less than $20 \mu\text{R/h}$, it will be assumed that there is no potential for residents to equal or exceed 100 mrem per year above background.

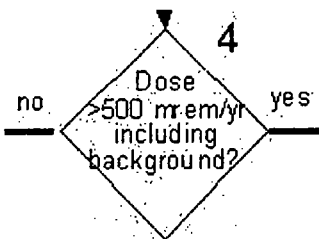
1.2 If the residents wish to enter the process but do not wish to allow technicians into their homes to perform screening with a meter, a dose assessment with TLD will be offered (item 3).



2 If the exposure rate in and around the dwelling does not have the potential to cause individual dose to equal or exceed 100 mrem per year above background, or if the residents decline a dose assessment, the process stops. If the exposure rate in and around the dwelling has the potential to cause residents to equal or exceed 100 mrem per year above background, a dose assessment will be offered (item 3).



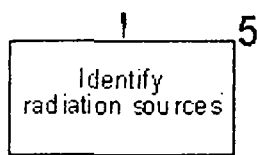
3 A dose assessment is different from a screening test in that actual dose to the residents of the dwelling is assessed rather than the exposure rate in the dwelling. Options available for dose assessment will include TLDs and survey meters.



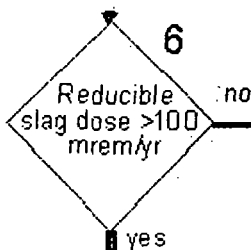
4 If the assessed dose exceeds 500 mrem per year, including natural background from external sources, a survey to identify radiation sources will be offered.

4.1 If the resident accepts, the survey to identify radiation sources will be performed (item 5)

4.2 If the resident declines the survey to identify radiation sources, the process stops. If the property owner wishes the property to be listed on an inventory, this will be done (item 9).



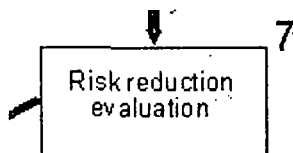
5 A survey to identify radiation sources is performed in an effort to determine the type and magnitude of the sources leading to the dose exceeding 500 mrem including background. Various techniques are available including exposure rate measurement, visual and chemical identification of slag and gamma-ray spectroscopy. These methods are detailed in the Exposure Study Work Plan.



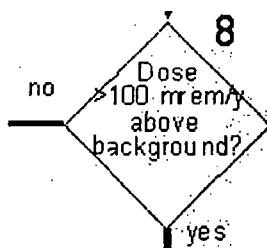
6 Based upon item 5 above, reducible slag dose is determined. Reducible slag dose comes from slag in dwellings. Examples of sources of dose that would not be considered reducible slag dose are dose from non-slag radioactive building materials in dwellings and dose received occupationally from slag.

6.1 If the survey to identify radiation sources indicates that reducible slag dose equals or exceeds 100 mrem per year, action is recommended (item 7).

6.2 If the reducible slag dose does not equal or exceed 100 mrem, the process stops. If the property owner wishes the property to be listed on an inventory, this will be done (item 9).



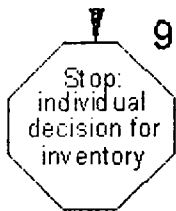
7 A list of possible actions for doses above 500 mrem including background is described in section V. C. of this document.



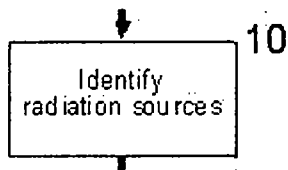
8 If the assessed dose is less than 100 mrem per year above background, the process stops. If the property owner wishes the property to be listed on an inventory, this will be done (item 9). If the dose exceeds 100 mrem per year above background, then a survey to identify radiation sources will be offered (item 10).

8.1 If the resident accepts, the survey to identify radiation sources will be performed (item 10).

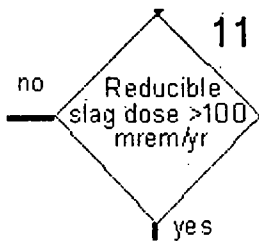
8.2 If the resident declines a survey to identify radiation sources, the process stops. If the property owner wishes the property to be listed on an inventory, this will be done (item 9).



9 Whenever a structure that contains slag is eliminated from further consideration for action, or slag remains after action is taken, listing of the structure on the slag inventory is offered to the owner. The permission of the owner (for private property) or the responsible public official (for public property) is required prior to listing.



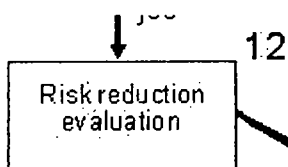
10 A Survey to identify radiation sources is performed in an effort to determine the type and magnitude of the sources leading to the dose exceeding 100 mrem above background. Various techniques are available including exposure rate measurement, visual and chemical identification of slag and gamma-ray spectroscopy. These methods are detailed in the Exposure Study Work Plan.



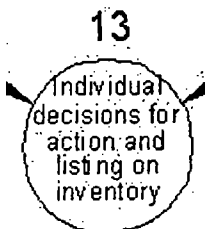
11 Based upon item 10 above, reducible slag dose is determined.

11.1 If the survey to identify radiation sources indicates the reducible dose due to slag equals or exceeds 100 mrem per year, risk reduction evaluation is offered (item 12).

11.2 If the reducible slag dose does not equal or exceed 100 mrem, the process stops. If the property owner wishes the property to be listed on an inventory, this will be done (item 9).



12 A "menu" of possible risk reduction options for doses in the range of 100 mrem per year above background to 500 mrem per year including background is available and is described in Section V. B. of this document.



13 The affected individual makes the final decision on action to be taken. If slag remains after action is taken, permission of the owner (for private property) or the responsible public official (for public property) would be required prior to listing on the inventory.

V. Menu of options for risk reduction actions

A. General Options

It is recommended that actions be considered to reduce exposure if a reduction of at least 100 mrem per year from slag can be achieved. The potential options identified for risk reduction actions are as follows:

- Education, counseling, and attrition
- Use modification
- Remodeling, shielding, and/or partial removal
- Additional living space

These options are defined in section D below. Some options are more difficult, time consuming, and costly than others. The options listed start with the easiest and least expensive and range up to the most difficult and costly. In general, simpler and easier options would be more appropriate for lower doses (near 100 mrem above background). More difficult options would be more appropriate at higher doses. The options on the risk reduction "menu" are not mutually exclusive and several or all could be utilized if needed. Other actions may be possible.

B. Menu for 100 mrem per year above background to 500 mrem per year including background

Since decisions regarding actions will be up to the individual and will involve specific and detailed evaluation of the home, the Technical Work Group considered whether the ranking of options within a "menu" provided sufficient guidance to individuals. The Work Group also considered whether sufficient data were available to provide a basis for recommending that particular options from a "menu" be associated with specific dose levels. A majority of the Work Group agreed that some additional detail was needed to show dose levels for which the various options could apply. These dose levels are intended as recommended guidance which is likely to be appropriate in most cases.

The following guidelines for risk reduction recommendations are intended to be general guidelines that are appropriate for the majority of people who are considering options to reduce their dose due to slag. These guidelines are not intended to restrict individual choice in reducing risk, but it should be understood that funds may not be available to address options outside these guidelines.

Cost effective risk reduction options should be considered on a case-by-case basis and each homeowner should have an opportunity to discuss their specific concerns with a radiation risk professional.

In the range from 100 mrem above background to 500 mrem including background, the guidance in the following menu is recommended by the Technical Work Group to aid individuals in selecting options if a reduction of at least 100 mrem per year from slag can be achieved.

Table V-1. Menu: Summary of guidelines for risk reduction actions for the range 100 mrem per year to 500 mrem per year including background.

Dose range (mrem per year)	Action
More than 100 above background	Education, counseling, and attrition
More than 200 above background	Above actions plus: use modification
More than 300 above background up to 500 including background	Above actions plus: remodeling, shielding, and/or partial removal

C. Options for greater than 500 mrem per year including background

For doses greater than 500 mrem per year including background, the Technical Work Group recommends that all options from the menu plus "additional living space" be considered for risk reduction if a reduction of at least 100 mrem per year from slag can be achieved. The options for greater than 500 mrem per year including background are not mutually exclusive and several could be utilized.

D. Explanations of action terms

1. Education / Counseling

Applicable dose range: more than 100 mrem above background

Education and counseling would include a balanced discussion of radiation risk and radiation protective measures. Commonly asked questions would be anticipated and answered. This would include exploring the range of possible actions that could be taken to reduce an individual's dose such as possible changes in use patterns (for example, spend less time in basement by moving primary living areas from basement to upper floors)

2. Attrition

Applicable dose range: more than 100 mrem above background

Attrition means removing slag once a structure's useful life has ended. Attrition includes 1) listing the location of the slag that triggered a dose over a Graded Decision Guideline level, 2) tracking the disposition of the material, and 3) eventually managing the disposal of the material. For example, once a structure has been listed on the inventory and is scheduled for demolition, the slag matrix would be picked up and removed to a disposal location. If an owner agreed to attrition, the owner would be automatically agreeing to the listing, tracking and disposal process.

3. Use modification

Applicable dose range: more than 200 mrem above background

Use modification refers to actively facilitating changes in home use that would reduce the amount of time that individuals spend in a space where slag significantly contributes to individual dose. An example is converting a basement bedroom to an alternative use for which individuals spend less time in the room.

4. Remodeling / shielding / partial removal

Applicable dose range: more than 300 mrem above background

Remodeling includes altering the design of a room to replace an existing slag-containing space that contributes significantly to individual dose. Or it may be feasible to remove the slag only in the area of elevated exposure rate. For example the shielding or removal of one wall in a high exposure rate area may reduce most of the individual dose in that particular area.

5. Additional living space

Applicable dose range: more than 500 mrem including background

This option would provide additional living space to eliminate current home use patterns that contribute to an elevated individual dose. For example building a new bedroom or other addition to replace a basement bedroom would reduce dose.

VI. Radon

What is radon?

Although not associated with slag or gamma radiation, indoor radon is an important contributor to radiation dose received in dwellings (Table II-1). For this reason it is recommended that radon measurements be offered to residents for whom surveys to identify radiation sources are performed (items 5 and 10 in section IV).

What should be done about it?

If the radon concentration exceeds the EPA action level of four picocuries per liter of air, radon reduction should be recommended to residents. EPA further recommends that if a level of two picocuries per liter of air is exceeded, residents should consider radon reduction. Radon reduction includes a graded series of actions such as sealing basement cracks, ventilating spaces with high radon levels, and installing sub-slab ventilation to reduce soil gas pressure under the foundation.

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